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Time Variable Gravity modeling for Precise Orbits across the TOPEX/Poseidon, Jason-1 and Jason-2 Missions

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Abstract

Modeling of the Time Variable Gravity (TVG) is believed to constitute one of the the largest remaining source of orbit error for altimeter satellite POD. The GSFC operational TVG model consists of forward modeling the atmospheric gravity using ECMWF 6-hour pressure data, a GRACE derived 20x20 annual field to account for changes in the hydrology and ocean water mass, and linear rates for C_{20}, C_{30}, C_{40}, based on 17 years of SLR data analysis (IERS 2010), and linear rates for C_{21}, S_{21} (IERS 2003) using the EIGEN-GL04S1 (a GRACE+Lageos-based geopotential solution). Although the GSFC Operational model can be applied from 1987, there may be long-term variations not captured by these linear models, and more importantly the linear models may not be consistent with more recent surface mass trends due to global climate change. We have evaluated the impact of TVG in two different ways: (1) by using the more recent EIGEN-6S gravity model developed by the GFZ/GRGS tearm, which consists of annual, semi-annual and secular changes in the coefficients to 50x50 determined over 8(?) years of GRACE+Lageos+GOCE data (2003-200?); (2) Application of 4x4 solutions developed from a multisatellite SLR+DORIS solution based on GGM03S that span the period from 1993 to 2011. We have evaluated the recently released EIGEN6s static and time-varying gravity field for Jason-2 (J2), Jason-1 (J1), and TOPEX/Posiedon (TP) Precise Orbit Determination (POD) spanning 1993-2011. Although EIGEN6s shows significant improvement for J2 POD spanning 2008 – 2011, it also shows significant degradation for TP POD from 1992. The GSFC 4x4 time SLR+DORIS-based series spans 1993 to mid 2011, and shows promise for POD. We evaluate the performance of the different TVG models basedon analysis oftracking data residuals use of independent data such as altimeter crossovers, and through analysis of differences with internally-generated and externally generated orbits.